

TS-8123 SUPER-HIGH-SPEED STORAGESCOPE

2500 div/ μ s (1 div = 12 mm) (analog) and 40 ps/word
(equivalent clock for digitizing)



GP-IB



IWATSU

Stripes in the background are stripes
on the storage target.

A Storagescope That Transcends Storage Oscilloscopes

Combines a 2500-div/ μ s super-high-writing speed storage oscilloscope, a 40ps/word(equivalent clock) A/D converter, and a 100-MHz oscilloscope

The need to view high-speed phenomena is accelerating with today's increasing semiconductor operating speed, growing research activities on nuclear fusion, etc. These needs have been solved by IWATSU with a super-high writing speed of 2500 divisions per microsecond (1 div = 12 mm).

In addition, a digitizing speed of 1000 div/ μ s, which is equivalent to the conversion speed of a 40-ps (25-GHz) clock can be obtained when waveforms are converted from analog to digital format after analog storage. Just 40 picoseconds — such speed is unattainable by conventional A/D converters.

Converted digital data are sent via the standard GP-IB interface, to a computer for digital signal processing.

The TS-8123 uses a large, 7-inch cathode ray tube (CRT) developed by IWATSU, which displays bright, sharp traces and further broadens the scope of measurements.

Display Modes

REAL

The real mode is used when the TS-8123 is used as a conventional oscilloscope.

ANALOG

Stored analog waveforms are displayed as analog forms in this mode.

DIGITAL

A/D converted waveforms are displayed in this mode.

PEN

The pen mode is used to output digitized waveforms to a pen recorder in analog form.

Bright, Sharp 7-Inch CRT

This large, 8 \times 10 division (1 div = 12 mm) CRT was developed by IWATSU. With an accelerating voltage of 20 kV, the CRT displays bright, sharp traces.

Vertical Axis Unit

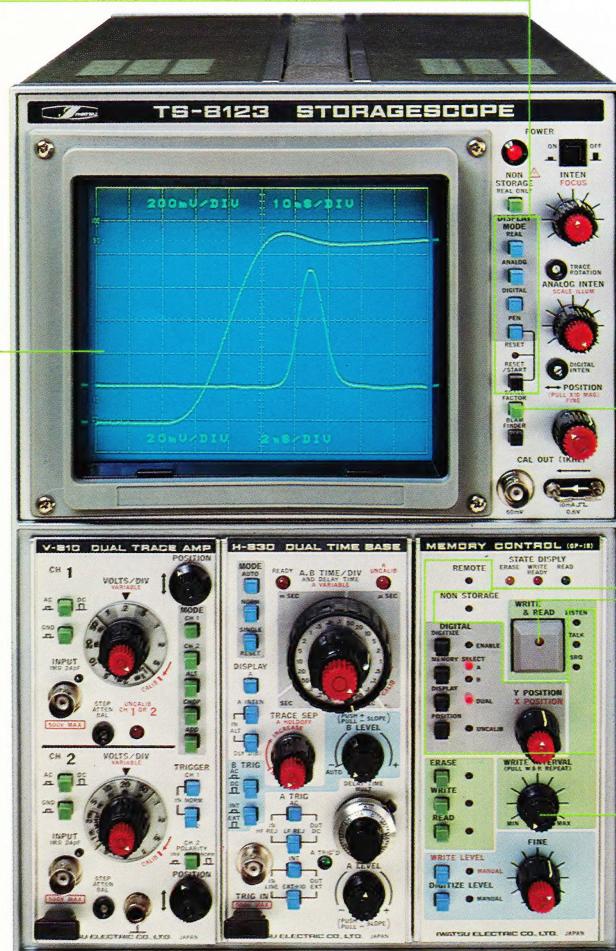
V-810

A standard unit of the 100-MHz plug-in series. It has a high deflection factor of 1 mV, and the scale factor (range display) is automatically switched to 1/10 when the supplied probe (1/10) is applied.

Horizontal Axis Unit

H-830

The H-830 is a double-time-base unit with main sweep and delayed sweep. Combined with a sweep magnifying function, the unit can provide high-speed sweep rate as fast as 2 ns/div. If ALT sweep is selected, A-sweep and delayed B-sweep are displayed simultaneously (real mode).



Scale Factor

Deflection factors and sweep rates are displayed as reference.

DIGITAL

DIGITIZE

When this switch is pushed, waveforms are stored, then converted from analog to digital. Equivalent clock rate of 25 GHz can be obtained.

MEMORY SELECT

A memory to store A/D converted data is selected. The TS-8123 has two memories, A and B. The MEMORY SELECT switch is used in both storing data and displaying stored waveforms.

DISPLAY

When this button is pushed in to the DUAL position, the data stored in both memories A and B are displayed.

POSITION

This switch is used for shifting stored digital waveforms.

REMOTE

This LED lights when the TS-8123 is controlled by the external controller.

LISTEN, TALK, SRQ

These LEDs light during GP-IB control.

WRITE & READ

The basic mode switch for storing waveforms. When this switch is pushed, the storage target of the scan converter tube is erased to allow storage of waveforms; and after a storage operation, the waveforms are displayed automatically.

WRITE INTERVAL

This knob is used to control waveform write and erase intervals. The operation is repeated if the control knob is pulled.



V-811 High Gain Plug-in Unit

Input	Differential input	Rise time	Approx. 350 ns
Deflection factor	10 μ V/div to 5 V/div, $\pm 2\%$	Input RC	$1 \text{ M}\Omega \pm 2\% / 48 \text{ pF}$ $\pm 5 \text{ pF}$
Noise	16 μ V or 0.1 div or less (measured by tangential method)	CMRR	100 dB or more
Frequency response	DC to 1 MHz ± 3 dB (DC coupling)	Highpass filter	100 Hz to 300 kHz, 1 MHz
		Lowpass filter	DC, 0.1 Hz to 10 kHz
		DC offset	Possible

FEATURES OF TS-8123 STORAGESCOPE

Built-In GP-IB interface and Digitizing of Stored Waveforms

The TS-8123 has a standard GP-IB interface so that data can be sent via the GP-IB interface to a computer for digital signal processing.

The TS-8123 records single phenomena in the scan converter tube as analog waveforms, and reads them by scanning with an electron beam.

In Analog Mode, it scans horizontally as shown in figure 1. When the DIGITIZE button for A/D conversion is depressed, the signal is detected by vertical scanning.

The TS-8123 scans 512 times to complete digitizing.

This method has the following advantages over the conventional A/D converter:

1. Super high speed
Equivalent to an A/D converter with a clock rate of 25-GHz.
Maximum sweep rate: 2 ns
Horizontal resolution: 512 (dots)
 $2 \text{ ns} \times 10 \text{ (div)} \div 512 = 40 \text{ ps} \rightarrow 25 \text{ GHz}$
2. Resolution is independent of input frequency.
3. Desired equivalent clock rates can be selected by turning the variable sweep control.

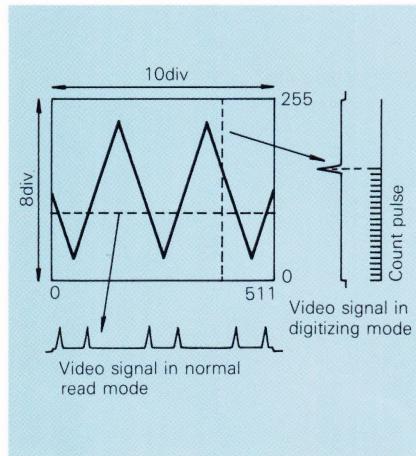


Figure 1

Write Condition Automatic Setting

The best write conditions are always automatically set, unlike ordinary storage oscilloscopes requiring adjustment of intensity and focus to suit the sweep range and input signals.

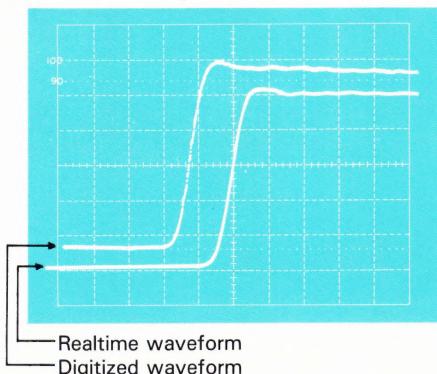
With the TS-8123, the internal microcomputer reads the sweep rate selected in a write operation and selects the best write current and focus voltage.

This microcomputer operation eliminates all the trouble of adjustments so that the operator can concentrate on measurements.

Waveforms Can Be Compared

Digitized waveforms can be compared among themselves and also with realtime waveforms.

Example of simultaneous display of a realtime waveform and a digitized waveform.

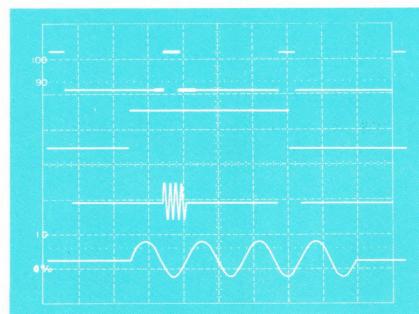


Unlike ordinary storage oscilloscopes, the TS-8123 permits observation of realtime signals without erasing stored waveforms.

Super High Speed and Large CRT Screen

The TS-8123 used separate CRTs for waveform storage and waveform display. The scan converter tube for waveform storage offers a writing speed of 2500 divisions per microsecond.

The large, 7-inch CRT for waveform display permits detailed observation of waveforms. This CRT allows display of bright, sharp traces.

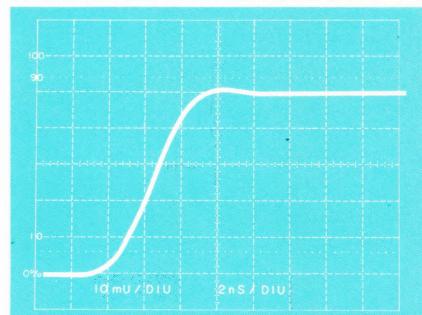


Examples of Waveforms captured by The TS-8123

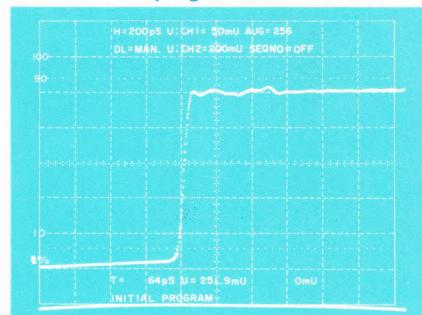
Input Signal

Rise time: Less than 300 ps

Waveform recorded with the TS-8130



Waveform observed with the IWATSU SAS-8130 Waveform Analyzer (which uses a 3.5-GHz sampling head)



Writing speed

The frequency of signals that the storage oscilloscope can record depends on writing speed, not on the frequency response of the oscilloscope.

Writing speed depends not only on frequency but on amplitude as well because of the electron beam velocity. Even if the frequency is within the rated range, storage oscilloscopes may be unable to write a waveform if the amplitude is too large. This relationship is illustrated in figure 2. For example, the TS-8123 can record a 100-MHz sine-wave signal at an amplitude of 8 divisions.

Stored Waveforms Can Be Monitored on Outside Monitor and Printed With Video Printer

A composite video signal output is provided for monitoring waveforms on the screen of an external monitor and printing with a video printer.

This feature is particularly effective when stored waveforms are observed and studied by a large number of persons simultaneously, and permanently recorded. The video output is also valuable for research institutes because waveforms can be monitored in areas remote from the storagescope.

Waveforms can also be recorded with video tape recorders (VTRs).

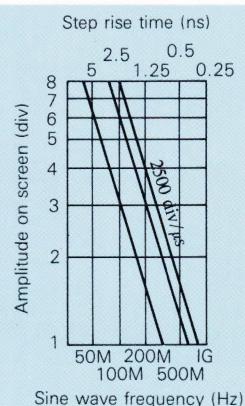
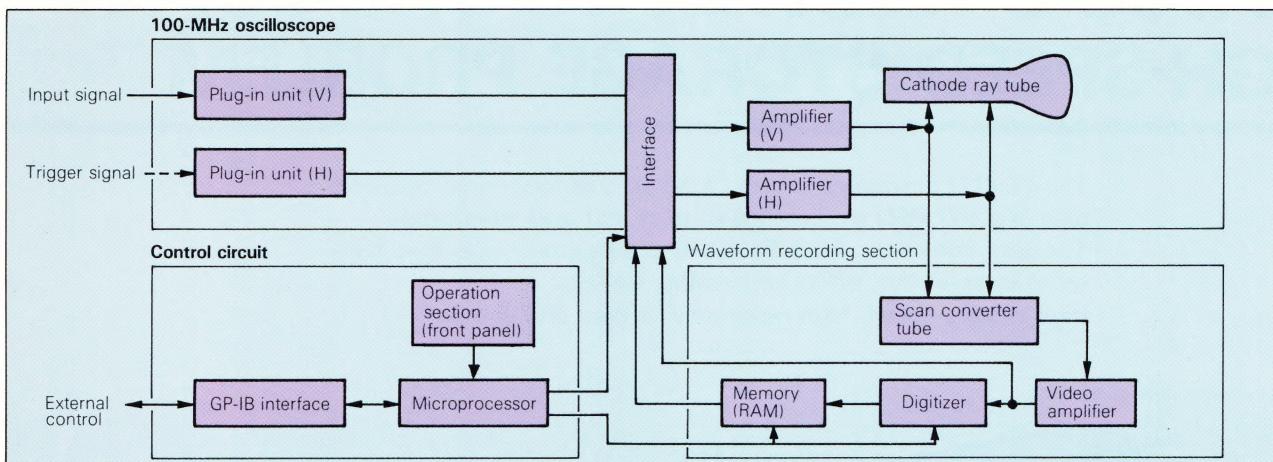


Figure 2

■ TS-8123 Configuration (Block Diagram)



List of TS-8123 GP-IB Instructions

Parameters are separated by spaces.

	Parameter 1	Parameter 2	Parameter 3	Parameter 4	
AC (LEVEL CONTROL)	(Level control) ϕ WRITE LEVEL 1 DIGITIZE LEVEL 2 READ LEVEL	(Mode) ϕ AUTO 1 MANUAL 2 EXTERNAL	(Setting) x x -32 ~ 31	x	
BC (LEVEL READ)	ϕ WRITE LEVEL 1 DIGITIZE LEVEL	x	x	x	(-32 ≤ data ≤ 31)
CL	x	x	x	x	DEVICE CLEAR
DF (DISPLAY SELECT)	ϕ As set on panel 1 REAL 2 ANALOG 3 DIGITAL 4 REAL-ANALOG 5 REAL-DIGITAL 6 ANALOG-DIGITAL 7 SCALE FACTOR 8 REAL SCALE FACTOR 9 ANALOG S.F. 10 DIGITAL-DIGITAL S.F.	(Memory select) ϕ A-memory 1 B-memory Omitted: As set before	(Digital display select) ϕ NORM 1 DUAL Omitted: As set before	(Digital display position) ϕ POS CAL 1 POS UNCAL Omitted: As set before	Local status continues unless instruction is set.
GT (OPERATION)	ϕ Write and Read start 1 Erase start 2 Write start 3 Read start	(Memory select) ϕ A-memory 1 B-memory 2 Not digitized Omitted: As set before	x	x	
IX (DATA WRITE)	(Data format) ϕ ASCII 1 Binary (1 byte, 8 bits) 2 Binary (2 bytes, 9 bits)	(Memory select) ϕ A-memory 1 B-memory (Not omitted)	(Start address) Omitted m	(Stop address) Omitted n	(0 ≤ m ≤ n ≤ 511) 512 data 1 data (n-m) + 1 data
	4 ASCII 5 Binary (1 byte, 8 bits) 6 Binary (2 bytes, 9 bits)		x	x	1024 data
JX (DATA READ)	ϕ ASCII 1 Binary (1 byte, 8 bits) 2 Binary (2 bytes, 9 bits) 3 XY range data + binary (2 bytes, 9 bits) 8 Interpolated ASCII 9 Interpolated binary (1 byte, 8 bits) 10 Interpolated binary (2 bytes, 9 bits) 11 XY range date + interpolated binary (2 bytes, 9 bits)	(Memory select) ϕ A-memory 1 B-memory (Not omitable)	(Start address) Omitted m	(Stop address) Omitted n	512 data 1 data at address m (n-m) + 1 data from addresses m to n (≤ m ≤ n ≤ 511)
	4 Interpolated ASCII 5 Interpolated binary (1 byte, 8 bits) 6 Interpolated binary (2 bytes, 9 bits)		x	x	1024 data
LX (SCALE FACTOR DATA READ)	ϕ REAL 1 ANALOG 2 DIGITAL A 3 DIGITAL B	x	x	x	
VI (PEN RESET)	(Memory select) ϕ A-memory 1 B-memory Omitted: As set before				
VT (PEN START)	(Pen speed) 0 ~ 4 Omitted: As set before	x	x	x	

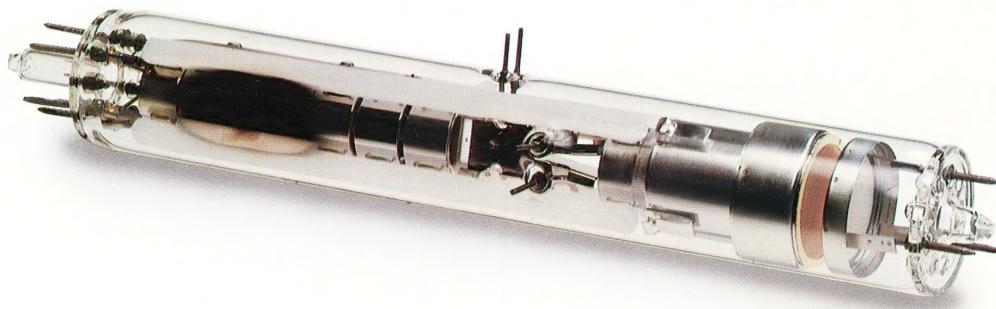
IWATSU'S ANSWER TO THE SUPER-HIGH-SPEED STORAGE PROBLEM

The TS-8123 Storagescope uses IWATSU's exclusive scan converter tube in a 100 MHz oscilloscope to store and read waveforms.

The scan converter, formally called a scan conversion type high-speed storage tube, offers outstanding features:

High writing speed, high resistance to burn and shock.

An external view of ST-100



The **ST-100** scan converter tube developed by IWATSU and incorporated into the storagescope TS-8123 offers great resistance to burn and super-high writing speed.

The secret lies in the storage target, which uses high-purity sapphire single crystal of low dislocation density. The **ST-100** basically consists of a compact electron gun, deflector, and storage target.

The tube is small and light, measuring 200 mm in overall length and 27 mm in outside diameter, and weighing 100 grams. It offers a wide enough bandwidth and high enough writing speed to write 100-MHz signals, and the storage face is of uniform, high quality.

The storage target of the **ST-100** has high-precision, fine metal electrode stripes photo-etched on a sapphire single-crystal substrate with a stripe pitch accuracy of within $0.1 \mu\text{m}$ to reduce non-uniformity to a minimum and assure high quality. Because of the sapphire single-crystal target, the amplitude is about 10 times better than that of a conventional storage target.

This means not only is high writing speed obtained but also even a 100-MHz signal can be read for longer than 30 seconds. Storage targets employing silicon P-N diode arrays lose the stored signals once the signals are read (destructive reading), but signals stored by the sapphire single-crystal target are not erased by reading (non-destructive reading). Non-destructive reading is particularly

convenient when reading stored signals as analog data because no buffer memory is necessary.

The storage tube used in an ordinary storage oscilloscope requires some care in handling to prevent permanent damages because the high secondary electron emission substance deposited on the metal mesh used as a storage target might be peeled by high-energy electron beam bombardment.

The **ST-100** has drastically altered the conventional concept of high-speed storage on this point, too, because the high-fusing-point metal stripe electrodes on the sapphire single-crystal substrate provide maximum resistance to such permanent damages.

The electron gun is also a product of IWATSU CRT technology. The electron gun consists of a static focusing section, deflection section, and a collimation section that directs an electron beam input perpendicular to the storage target. IWATSU's high-frequency electron gun design technology was utilized to achieve high sensitivity and high beam-current density, thereby enabling high-speed writing. The problem of electron beam non-uniformity during reading, which was raised with the direct-view type storage tube used in conventional storage oscilloscopes, was solved in the **ST-100** by incorporating a specially designed collimation section.

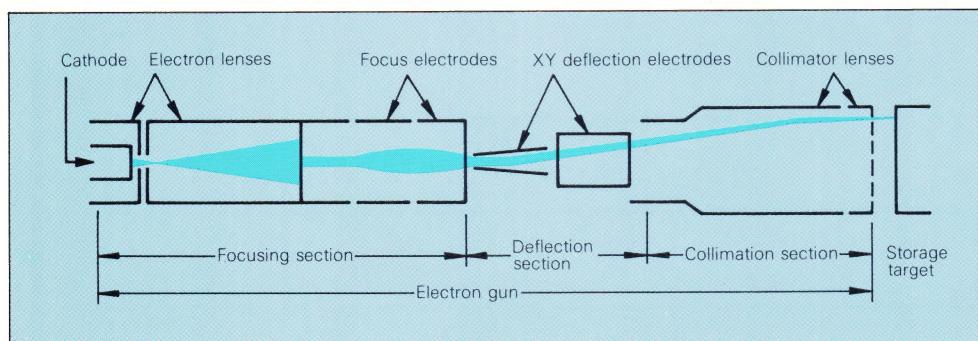


Figure 3 Composition of ST-100 Scan Converter Tube



Prefined stripes on storage target

ASAHISE
TOKYO, 1
CABLE A

MAIN P
OSCIL
LOGIC
DATA A
DIGITA

SPECIFICATIONS

(TS-8123 With Plug-In Units V-810 and H-830)

CRT

CRT
Display area 7-inch rectangular
8 x 10 divisions (1 division = 12 mm),
with parallax-free internal graticule and
scale illumination
Accelerating voltage Approximately 20 kV

Analog Recording

Maximum writing speed 2500 divisions/ μ s
Read time 30 seconds or more

Digital Recording

Maximum writing speed 1000 divisions/ μ s
Resolution Y axis: 8 bits
X axis: 512 words
A, B (up to two data inputs can be
recorded)

Vertical Deflection

Modes CH1, CH2, ALT, CHOP, ADD
1 mV/div to 5 V/div
Accuracy: 1 mV/div,
2 mV/div \pm 4%
5 mV/div to 5 V/div \pm 2%
1 mV/div to 12.5 V/div
continuously variable with VARIABLE
control
DC coupling: DC to 100 MHz, -3 dB
AC coupling: 10 Hz to 100 MHz, -3 dB
(10 mV/div to 5 V/div)

Approximately 3.5 ns

AC, GND, DC
Direct: 1 M Ω \pm 2% // 24 pF \pm 2 pF
Direct: 500 V (DC + AC peak)
Provided

Triggering

A-trigger INT (CH1, CH2, NORM), LINE, EXT,
EXT \div 10
Signal source AC, HF REJ (AC), LF REJ (AC), DC
Coupling 1 M Ω
External input resistance 1 M Ω

Frequency range	Amplitude	
	INT	EXT
DC ~ 10MHz	0.3div	100mVp-p
10MHz ~ 50MHz	1.0div	150mVp-p
50MHz ~ 100MHz	1.5div	150mVp-p

B-trigger

Signal source INT (CH1, CH2, NORM), EXT
Coupling AC, DC
External input resistance 1 M Ω

Frequency range	Amplitude	
	INT	EXT
DC ~ 10MHz	0.3div	100mVp-p
10MHz ~ 50MHz	0.0div	150mVp-p

Horizontal Deflection

Mode A, A INTEN, ALT, B (DLY'D)
A-sweep AUTO, NORM, SINGLE
Sweep rate 20 ns/div to 0.5 s/div
Accuracy: \pm 2% (10° to 35°C)
Variable with control
Hold-off time Runs after delay, triggered delay
B-sweep 20 ns/div to 50 ms/div
Delayed sweep Accuracy: \pm 2% (10° to 35°C)
Sweep rate 1 μ s to 5 seconds
Delay time 10 times (main frame operation)
Sweep magnification 0.5 Vp-p
External intensity modulation

Calibrator

Output waveform
Output voltage
Output current

Square-wave 1 kHz \pm 1%
60 mV, 0.6 V \pm 1%
10 mA \pm 1%

Signal Outputs

Gate output
Sawtooth output
Video signal
D/A output

A-gate and B-gate: Approximately 1 V
A only: Approximately 250 mV/div
Composite video signal
Digitized waveform: X = 5 V, Y = 4 V,
Z = 5 V

Power Supply

Voltage range
Frequency
Power consumption

AC 100/117/217/234 V, \pm 10%

50 Hz/60 Hz

Approximately 160 W

Approximately 23 kg (50.6 lbs) (with
plug-in units)

Weight

220 \pm 2(W) \times 314 \pm 2(H) \times 520 \pm 2
(L) (mm)

8.66 \pm 0.08(W) \times 12.36 \pm 0.08(H) \times

20.47 \pm 0.08(L) (in)

Accessories to TS-8123

Power cord (1), fuses (2),

adjusting screwdriver (1),

accessory bag (1), instruction manual (1)

Accessories to V-810:

Probes (SS-0012R) 1.5 m (2), ad-
justing screwdriver (1), instruction
manual (1)

Accessories to H-830:

Instruction manual (1)

Dimensions

220 \pm 2(W) \times 314 \pm 2(H) \times 520 \pm 2
(L) (mm)

8.66 \pm 0.08(W) \times 12.36 \pm 0.08(H) \times

20.47 \pm 0.08(L) (in)

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manual (1)

Accessories to H-830:

Instruction manual (1)

Accessories

Specifications of SS-0012R probe

Connector BNC
Cord Approximately 1.5 m
Attenuation ratio 10 : 1
Input RC 10 M Ω ,
approximately 14 pF
Maximum input voltage 600 V (DC + AC peak)
Frequency bandwidth DC to 100 MHz, -1 dB (probe alone)

GP-IB Functions

(Conforms to IEEE Std 488-1978)

Subset	Function
SH1	Complete source handshake
AH1	Complete acceptor handshake
T6	Basic talker function, serial poll, and MLA talker release capability
L4	Basic listener and MTA listener release function
SR1	Service request capability
RL1	Remote/local function
PP ϕ	No parallel poll
DC1	Device clear capability
DT ϕ	No device trigger capability
C ϕ	No controller function

Accuracy at temperatures between +10°C (50°F) and +35°C (77°F)

Specifications are subject to change without notice.



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